LITHOTRITY IN CASES OF STONE:

22

SIMPLE AND COMPLICATED

BY

HERBERT MILTON, M.R.C.S. Eng.,

PRINCIPAL MEDICAL OFFICER, KASR-EL-AINI HOSPITAL, CAIRO.

Reprinted from THE LANCET, April 18 and 25, and May 2, 1896.

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TABLE I.—ANALYSIS OF 200 CASES OF STONE.

—	—	Total.	Age.			Sex.		Result.		Nature of operation.						Weight of stone in grammes.								Composition of stone.										
			0–29	30–59	60+	Male.	Female.	Cured.	Died.	Lateral lithotomy.	Supra-pubic lithotomy.	Lithotrity.	Perineal lithotrity.	Laparotomy.	Others.	0–24	25–49	50–74	75–99	100–149	150–199	200–299	300+	Oxalates.	Oxalates and Phosphates.	Urates.	Urates and Phosphates.	Oxalates and Urates.	Oxalates, Urates, and Phosphates.	Phosphate of lime.	Mixed phosphates.	Cystine.	Urostealith.	Xanthine.
—	Total.	200	67	113	20	198	2	190	10	28	6	141	21	3	1	118	49	12	11	3	5	1	1	13	16	20	68	16	14	3	46	2	1	1
Age...	0–29	67	67	—	—	65	2	67	—	18	1	37	11	—	—	40	15	4	5	—	3	—	—	4	2	9	24	7	2	—	17	2	—	—
	30–59	113	—	113	—	113	—	106	7	8	5	90	8	1	1	66	29	7	6	3	1	1	—	8	13	7	36	9	11	3	24	—	1	1
	60+	20	—	—	20	20	—	17	3	2	—	14	2	2	—	12	5	1	—	—	1	—	1	1	1	4	8	—	1	—	5	—	—	—
Sex...	Male	198	65	113	20	198	—	188	10	27	6	140	20	3	1	116	49	12	11	3	5	1	1	13	16	20	68	16	14	3	44	2	1	1
	Female	2	2	—	—	—	2	2	—	1	—	1	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—
Result ...	Cured	190	67	106	17	188	2	190	—	28	3	138	20	1	—	117	45	12	10	3	5	—	1	12	16	20	63	16	14	3	42	2	1	1
	Died	10	—	7	3	10	—	—	10	—	3	3	1	2	1	1	4	—	1	1	2	1	—	1	—	—	5	—	—	—	4	—	—	—
Operation ...	Lateral	28	18	8	2	27	1	28	—	28	—	—	—	—	—	25	3	—	—	—	—	—	—	2	3	5	8	2	—	—	7	1	—	—
	Suprapubic	6	1	5	—	6	—	3	3	—	6	—	—	—	—	1	1	—	2	1	1	—	—	—	—	3	1	—	—	—	2	—	—	—
	Lithotrity	141	37	90	14	140	1	138	3	—	—	141	—	—	—	89	41	9	2	—	—	—	—	10	10	11	52	10	11	3	31	1	1	1
	Perineal lithotrity	21	11	8	2	21	—	20	1	—	—	—	21	—	—	3	4	3	6	2	3	—	—	1	2	1	5	4	3	—	5	—	—	—
	Laparotomy	3	—	1	2	3	—	1	2	—	—	—	—	3	—	—	—	—	—	—	1	1	1	—	1	—	1	—	—	—	1	—	—	—
	Other	1	—	—	1	1	—	—	1	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Weight in grammes ...	0–24	118	40	66	12	116	2	116	1	25	1	89	3	—	—	118	—	—	—		—	—	—	12	9	14	40	8	9	1	21	2	1	1
	25–49	49	15	29	5	49	—	45	4	3	1	41	4	—	—	—	49	—	—	—	—	—	—	1	3	1	17	3	4	2	18	—	—	—
	50–74	12	4	7	1	12	—	12	—	—	—	9	3	—	—	—	—	12	—	—	—	—	—	—	—	1	5	2	—	—	4	—	—	—
	75–99	11	5	6	—	11	—	11	1	—	2	2	6	—	1	—	—	—	11	—	—	—	—	—	1	4	3	1	1	—	1	—	—	—
	100–149	3	—	3	—	3	—	2	1	—	1	—	2	—	—	—	—	—	—	3	—	—	—	—	1	—	1	1	—	—	—	—	—	—
	150–199	5	3	1	1	5	—	3	2	—	1	—	3	1	—	—	—	—	—	—	5	—	—	—	1	—	2	1	—	1	—	—	—	—
	200–300	1	—	1	—	1	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—
	300+	1	—	—	1	1	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—
Nature ...	Oxalates	13	4	8	1	13	—	12	1	2	—	10	1	—	—	12	1	—	—	—	—	—	—	13	—	—	—	—	—	—	—	—	—	—
	Oxalates and phosphates	16	2	13	1	16	—	16	—	3	—	10	2	1	—	9	3	—	1	1	1	1	—	—	16	—	—	—	—	—	—	—	—	—
	Urates	20	9	7	4	20	—	20	—	5	3	11	1	—	—	14	1	1	4	—	—	—	—	—	—	20	—	—	—	—	—	—	—	—
	Urates and phosphates	68	24	36	8	68	—	63	5	8	1	52	5	1	1	40	17	5	3	1	2	—	—	—	—	—	68	—	—	—	—	—	—	—
	Oxalates and urates	16	7	9	—	16	—	16	—	2	—	10	4	—	—	8	3	2	1	1	1	—	—	—	—	—	—	16	—	—	—	—	—	—
	Oxalates, urates, and phosphates	14	2	11	1	14	—	14	—	—	—	11	3	—	—	9	4	—	1	—	—	—	—	—	—	—	—	—	14	—	—	—	—	—
	Phosphate of lime	3	—	3	—	3	—	3	—	—	—	3	—	—	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—
	Mixed phosphates	46	17	24	5	44	2	42	4	7	2	31	5	1	—	21	18	4	1	—	1	—	1	—	—	—	—	—	—	—	46	—	—	—
	Cystine	2	2	—	—	2	—	2	—	1	—	1	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—
	Urostealith	1	—	1	—	1	—	1	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	Xanthine	1	—	1	—	1	—	1	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1

TABLE II.—ANALYSIS OF STONES WEIGHING FIFTY GRAMMES AND OVER.

—	—	Total.	Age.			Sex.		Result.		Nature of operation.						Weight of stone in grammes.								Composition of stone.									
			0–29	30–59	60 +	Male.	Female.	Cured.	Died.	Lateral lithotomy.	Supra-pubic lithotomy.	Lithotrity.	Perineal lithotrity.	Laparotomy.	Others.	0–24	25–49	50–74	75–99	100–149	150–199	200–299	300 +	Oxalates.	Oxalates and phosphates.	Urates.	Urates and phosphates.	Oxalates and urates.	Oxalates, urates, and phosphates.	Phosphate of lime.	Mixed phosphates.	Cystine.	Urostealith.
—	Total	50	17	28	5	50	—	42	8	—	11	15	20	3	1	—	—	19	13	8	6	1	3	2	4	12	15	6	1	—	10	—	—
Age	0–29	17	17	—	—	17	—	16	1	—	3	3	11	—	—	—	—	7	5	—	4	—	1	—	1	6	4	4	—	—	2	—	—
	30–59	28	—	28	—	28	—	23	5	—	7	11	8	1	1	—	—	11	8	6	1	1	1	2	3	5	9	2	1	—	6	—	—
	60 + ...	5	—	—	5	5	—	3	2	—	1	1	1	2	—	—	—	1	—	2	1	—	1	—	—	1	2	—	—	—	—	—	—
Sex	Male	50	17	28	5	50	—	42	8	—	11	15	20	3	1	—	—	19	13	8	6	1	3	2	4	12	15	6	1	—	10	—	—
	Female	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Result	Cured...	42	16	23	3	42	—	42	—	—	6	15	20	1	—	—	—	19	12	5	4	—	2	2	3	11	11	6	1	—	8	—	—
	Died	8	1	5	2	8	—	—	8	—	5	-	—	2	1	—	—	—	1	3	2	1	1	—	1	1	4	—	—	—	2	—	—
Operation	Lateral	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Supra-pubic	11	3	7	1	11	—	6	5	—	11	—	—	—	—	—	—	3	2	4	1	—	1	2	—	5	2	—	—	—	2	—	—
	Lithotrity	15	3	11	1	15	—	15	—	—	—	15	—	—	—	—	—	11	3	—	—	—	1	—	1	3	6	1	—	—	4	—	—
	Perineal lithotrity	20	11	8	1	20	—	20	—	—	—	—	20	—	—	—	—	5	7	4	4	—	—	—	2	4	5	5	1	—	3	—	—
	Laparotomy	3	—	1	2	3	—	1	2	—	—	—	—	3	—	—	—	—	—	—	1	1	1	—	1	—	1	—	—	—	1	—	—
	Other...	1	—	1	—	1	—	—	1	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Weight in grammes ...	0–24...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	25–49...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	50–74...	19	7	11	1	19	—	19	—	—	3	11	5	—	—	—	—	19	—	—	—	—	—	1	—	4	6	3	—	—	5	—	—
	75–99...	13	5	8	—	13	—	12	1	—	2	3	7	—	1	—	—	—	13	—	—	—	—	—	1	5	4	1	1	—	1	—	—
	100–149	8	—	6	2	8	—	5	3	—	4	—	4	—	—	—	—	—	—	8	—	—	—	1	1	2	1	1	—	—	2	—	—
	150–199	6	4	1	1	6	—	4	2	—	1	—	4	1	—	—	—	—	—	—	6	—	—	—	1	1	2	1	—	—	1	—	—
	200–299	1	—	1	—	1	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—
	300 + ...	3	1	1	1	3	—	2	1	—	1	1	—	1	—	—	—	—	—	—	—	—	3	—	—	—	2	—	—	—	1	—	—
Nature	Oxalates	2	—	2	—	2	—	2	—	—	2	—	—	—	—	—	—	1	—	1	—	—	—	2	—	—	—	—	—	—	—	—	—
	Oxalates and phosphates	4	1	3	—	4	—	3	1	—	—	1	2	1	—	—	—	—	1	1	1	1	—	—	4	—	—	—	—	—	—	—	—
	Urates	12	6	5	1	12	—	11	1	—	5	3	4	—	—	—	—	4	5	2	1	—	-	—	—	12	—	—	—	—	—	—	—
	Urates and phosphates	15	4	9	2	15	—	11	4	—	2	6	5	1	1	—	—	6	4	1	2	—	2	—	—	—	15	—	—	—	—	—	—
	Oxalates and urates	6	4	2	—	6	—	6	—	—	—	1	5	—	—	—	—	3	1	1	1	—	—	—	—	—	—	6	—	—	—	—	—
	Oxalates, urates, and phosphates	1	—	1	—	1	—	1	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—
	Phosphates of lime	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Mixed phosphates	10	2	6	2	10	—	8	2	—	2	4	3	1	—	—	—	5	1	2	1	—	1	—	—	—	—	—	—	—	10	-	—
	Cystine	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Urostealith	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

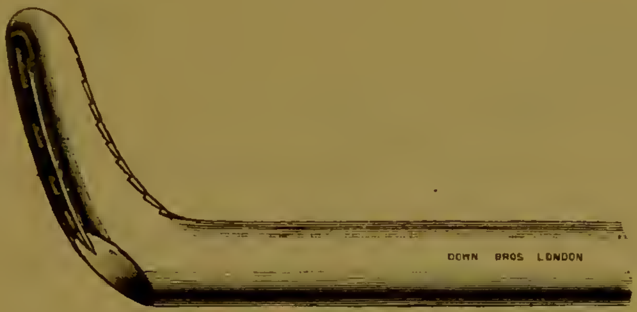
LITHOTRITY IN CASES OF STONE: SIMPLE AND COMPLICATED.

LIKE most surgeons called upon to treat a large number of calculous patients I consider that Bigelow's operation has proved itself to be in expert hands capable of yielding the best results in all simple cases of stone in children and in adults. I do not intend, therefore, to enter into any discussion as to the relative values of the different operations practised for the relief of vesical calculus, but simply to record my experience of lithotrity, to describe a few modifications which I have found useful in its practice, and, finally, to consider how far it is capable of maintaining its superiority in the presence of the complications most frequently met with in cases of bladder stone. I have in the title of this paper divided cases into two categories—simple and complicated. By a simple case I mean a stone of moderate dimensions and hardness situated in the bladder cavity of an adult or adolescent patient whose urethra is of at least normal dimensions, and who is free from any other important disease either of the urinary or of the general system. By a stone of moderate dimensions and hardness I mean one not exceeding 50 grammes (about 2 oz.) in weight and capable of being crushed by a No. 12 or 14 lithotrite. By a urethra of normal dimensions I mean one which will take without strain a No. 12 or 14 catheter of the English scale. Other cases I consider to be complicated, and it is evident, therefore, that a large proportion of all stones met with enter into this category. The complications to which I propose to refer are those arising from: (1) the size of the stone and its hardness; (2) its position; (3) the incomplete development of infancy and childhood; (4) old age and its associated degenerations; (5) various pathological conditions of the urinary system; and (6) the general condition of the patient. My remarks are based on the records of 209 cases contained in the following tables.

Table I. contains every case of stone in the bladder that I have operated on since the beginning of 1892 up to No. 200 with two exceptions. The first case not included occurred in a boy admitted with typhus fever, during the progress of which he was attacked with retention of urine. On passing a catheter a stone was detected, and it was decided to operate in order to prevent the urinary retention and other symptoms of stone from aggravating his disease. The stone was small and the operation (lithotomy) very simple; but the boy succumbed three days later to the typhus fever. The second case not included died under chloroform from chloroform poisoning. I had performed a few stone operations before 1892, but unless there was some great peculiarity had kept neither notes nor stones. In the beginning of that year I took over the whole of the operations for stone in the Cairo Hospital and commenced my collection and my record. In composing the tables I have taken advantage of the principle of the magic square. Having classified the cases according to the various conditions usually considered important in stone operations, age and sex of the patient, nature of operation and its result, the size of the stone and its chemical composition, I have been able, by adopting this principle, to show the relation of each one of these conditions to each one of the others. Under the heading of age I have divided my patients into the three periods of youth, middle age, and old age, allotting thirty years to each of the first two periods. The usual tendency in modern classifications has been to divide cases into children and others, or in the case of one of our greatest operators into old men and others. My experience has been, as with other surgeons, that the older the patient the more dangerous the operation becomes, with the proviso. however, that the age of the patient does not depend solely on the number of years he has lived. The other headings require no special notice, but I would draw attention to the columns showing the composition of the stones. It is remarkable that in so small a collection there should be so many examples of the rarer constituents. The analyses are above suspicion, having been made by a first-class analytical chemist, who has examined every stone for every possible constituent. I think that the remarkable results are due to the accuracy of the examinations, many constituents being detected which a more superficial examiner might have missed. In any case the presence of two stones containing cystine, of one composed almost entirely of urostealith, and of one containing xanthine in such a small collection is not in accordance with the experience of other operators. It is difficult to determine what proportion of the above cases should come under the category of "simple," for the reason that my records are not accurate enough as to the condition of the urinary and other organs, and I cannot, therefore, say what proportion of the simple cases have been treated by each of the various forms of operation. It will be seen, however, that 141 of the patients have been treated by urethral lithotrity, with a total mortality of 3. In one of three fatal cases the patient was more than eighty years old and had a stone of nearly two ounces; in the second the patient's age was about fifty-five, and his condition was complicated by fœtid cystitis in a very sacculated bladder; while the third patient was thirty-five years old and the subject of advanced kidney disease.

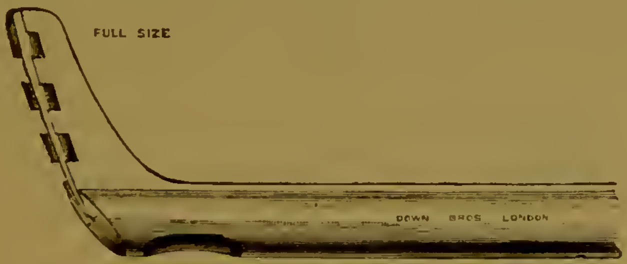
In performing lithotrity I have always carried out the method recommended by Bigelow—viz., complete evacuation of the stone at a single sitting. The patient has been in all cases prepared by one day's milk diet followed by a brisk purge. The operation has always been performed under chloroform narcosis. It is quite needless for me to describe in any way the technique of this operation, which has been brought to great perfection in many parts of the world, and more especially at the hands of some of our Indian surgeons. I doubt whether any other method will or can ever give in simple cases better results than this has given and it seems almost futile to attempt to modify it. I have, however, been induced to attempt a modification which, though unlikely to be attended by better results in simple cases, may be of service in a complication to be referred to later, and may, perhaps, recommend itself to the patient and surgeon from the simplicity and ease with which it may be carried out. Bigelow's operation necessitates the introduction into the bladder of two different instruments—the lithotrite and the evacuating tube. Each of these may require to be introduced several times before all the fragments are brought away. My object has been to construct a single instrument combining the functions of the two, and therefore capable of completing the operation with a single introduction. After the expenditure of much careful labour and the exercise of much ingenuity Messrs. Down Brothers have manufactured for me a lithotrite (Figs. 1 and 2) which partly, at all events, fulfils both those functions. This instrument in general

FIG. 1.



Distal end of lithotrite.

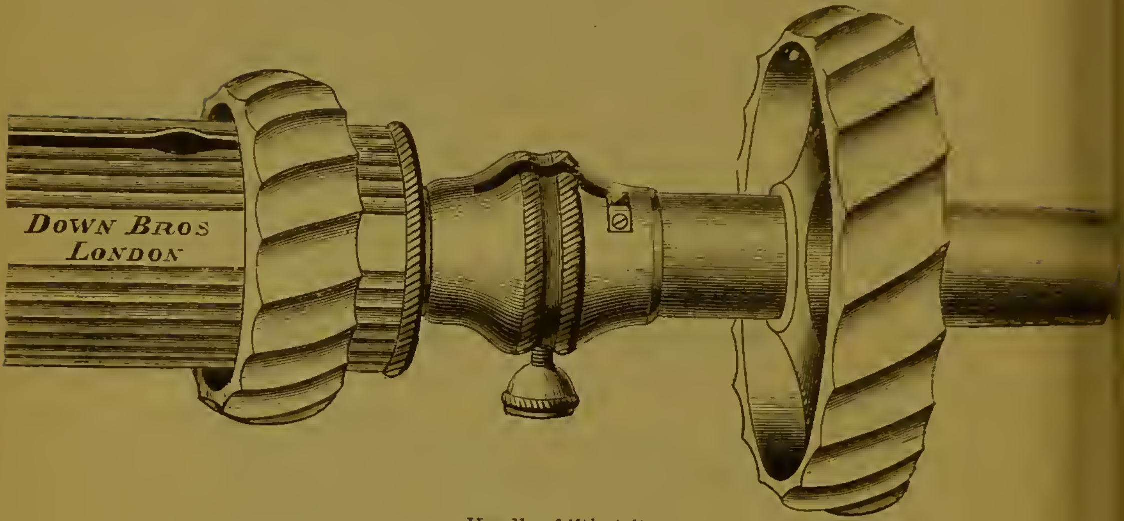
FIG. 2.



Distal end of male blade.

shape and appearance resembles an ordinary lithotrite. The female blade is, however, hollowed out to a larger extent than usual, so as to receive the tube which is attached along the whole length of the male blade. This tube presents

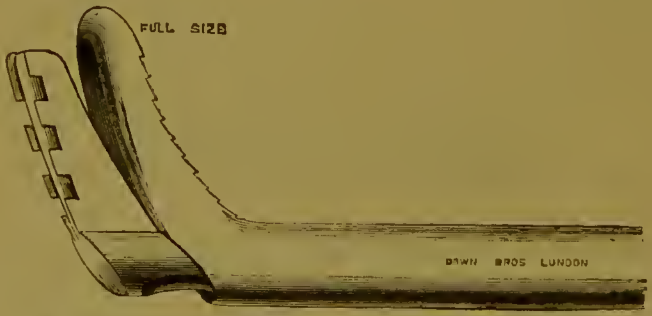
Fig. 3.



Handle of lithotrite.

on its lower surface, just below the jaw of the male blade, a large opening, beyond which its end is filled up as in an aseptic catheter. The tube, continued through the centre of the screw, expands beyond the handle (Fig. 3) to receive the

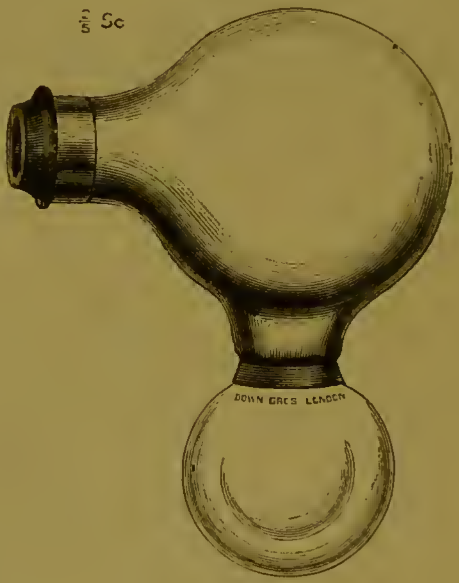
Fig. 4.



Protrusion of male blade through female during evacuation.

evacuating syringe. The male and female blades are so adjusted that when it is desired to aspirate the male jaw can be made to pass right through the female jaw, protruding to the extent of about four lines (Fig. 4) sufficiently to expose the eye of the male blade beyond the heel of the female. A stop situated in the handle of the instrument prevents this protrusion during such time as the instrument is being used for crushing. The reunion of the two functious of crusher and evacuator limits, as might be expected, the range of each. The instrument is of necessity weaker than an ordinary lithotrite of the same calibre. This has to a certain extent been remedied by the addition of a solid steel core, which, passing down the whole length of the tube, greatly adds to the strength of the instrument when crushing. This lithotrite is capable of crushing, and has crushed, a fairly hard calculus of 50 grammes; it must, however, always be used with great care and delicacy when dealing with such stones. The vast majority of stones, however, fall short of these dimensions and are such as to be quite readily crushed by this instrument. It is, moreover, chiefly in the case of old subjects that I think this method is likely to be most useful. When dealing with such cases it becomes of vital importance to treat the prostate as delicately as possible, and it is here that the great advantage of the single introduction will be found to lie. In these subjects, also, the stone, although apt to be large, is generally phosphatic in nature and friable, and under such circumstances the lithotrite is capable of dealing with quite large masses. As an evacuator, also, the instrument is less efficient than an evacuating tube of a similar gauge. The bore of the tube of a No. 14 evacuating lithotrite is equal only to that of a No. 11 or No. 12 catheter. The operation is necessarily, therefore, more prolonged, as the fragments must be broken up more finely. The instrument has, however, advantages which I think more than counterbalance these drawbacks. The single introduction which alone is necessary greatly diminishes the injury done to the urethra and prostate. In a healthy adult this has not the same importance as in an old man suffering from a large prostate. It is, however, especially in the latter class of cases that lithotrity becomes attended with danger, and it is in these cases that I think the modification is most likely to be of use. Secondly, it enables the operation to be made without anæsthesia where there is no special difficulty and where the patient prefers to avoid the administration of an anæsthetic. The operation without anæsthetics, however, requires very careful and very delicate manipulations, and should only be attempted when the patient objects to the narcosis or when there are other reasons against it. It must be limited further to cases in which the stone is small and easily friable. After the short experience I have had I would say that while advocating the evacuating lithotrite for use in the removal of small stones I can adduce no evidence to show its superiority in such cases to the ordinary instrument, and that I do not think it possible that its use will give any better results than those obtainable with Bigelow's method and instruments The only advantage that I can see for it is in the possible diminution of the necessity for narcosis. I shall refer to the use of the instrument in complicated cases further on. I wish to say here a few words as to the evacuating syringe. I have used chiefly the syringes introduced by Thompson and by Golding-Bird. Of the two I consider the latter to be preferable; it is simple in construction, easily filled, and readily used. I have lately had made for me by Messrs. Down Brothers a syringe (Fig. 5) which possesses these advantages to a still greater extent. It consists of an indiarubber syringe shaped like a pear, with two stems, the one at right angles to the other. The horizontal stem carries a vulcanite socket to receive the evacuating tube. The vertical stem terminates in a glass receptacle for the débris. There are no valves and no taps, the action of gravity alone being sufficient to prevent the return of the débris into the bladder cavity. The filling of this syringe is quite simple. The hole being held uppermost, water is poured in from the tap or jug. When three-quarters full the syringe must be slightly tilted to empty the glass receptacle of air. The removal of débris from the syringe is equally simple. The orifice should be closed with the thumb and the syringe inverted, so that, the glass receptacle being the highest part, the fragments fall into the ball cavity. The syringe is then turned so that the orifice becomes the lowest part, and the débris escapes with the water, one or two squeezes serving to expedite the escape. In addition to these advantages which it shares with other

FIG. 5.



Evacuating syringe.

models this instrument possesses two peculiarly its own. In the first place, the mounts being of vulcanite, it can be easily sterilised. This point has not received, I think, sufficient consideration, and it is very easy to see that an infected syringe might have a very prejudicial effect on the result of an operation. Secondly, it enables the operator to have full control over the movements of the evacuating tube in the bladder. This is a point of very great importance, especially towards the close of an operation, and is not possessed by any of the more modern evacuators. It may further be added that it is greatly cheaper than any other form. The manipulation of the syringe when in use is very simple. The compression should always be gradual and but little water should be injected into the bladder. The expansion of the syringe should be sudden so that all fragments are easily lifted by the current. A very slight pause should be made before each compression of the syringe so as to allow the fragments to settle into the recipient. Having used this evacuator some sixty times I can confidently recommend it to other operators. In general I would say, therefore, with regard to simple cases of stone in the bladder that by far the best operation and the one which gives the best results is lithotrity at a single sitting, and that the use of an evacuating lithotrite may be useful in some cases.

With regard to complicated cases of stone, I have already mentioned the complications I propose to refer to and shall consider them in the order given. The first is that arising from the largeness and hardness of the stone. Table II. has been drawn up with reference to this complication and contains all the stones that I have operated on whose weight has reached 50 grammes. Thirty-two of these cases are taken from Table I.; nine of them were operated on before 1892. The specimens and records of these nine cases were preserved on account of the abnormal dimensions of the stones Being selected cases they are not admissible in the general table, but the reason for their selection makes them specially suitable for Table II. The remaining nine form a portion of my third hundred, which is not yet completed. I have fixed the minimum weight for a large stone at 50 grammes, or a little less than two ounces. This limit is of course arbitrary. My reasons for choosing it are (1) it is numerically convenient; (2) few stones reach this size; (3) in all tables, old and new, the mortality attending operations on stones over this limit rises greatly; (4) I consider this to be about the limit at which a stone can be extracted from the wound of a perineal cystotomy in an adult without bruising or laceration of the tissues; and (5) it is about this limit that the difficulties of lithotrity begin. The arrangement of this table resembles that of Table I. and requires no further remark except with regard to the one operation classified as "other." This was a case in which the stone was lodged partly in the bladder and partly in the right ureter. It required for its removal a special operation, which is referred to later. Of the 50 cases here classified, 35 were operated on by lithotrity; of these not a single one died. When it is considered that in 8 of these cases the stone weighed between 2 and 3 ounces, in 10 between 3 and 4, in 8 between 4 and 8, and in one case over 12 ounces, it will, I think, be granted that no other operation has ever yielded such favourable results.[1] The cases have in no ways been picked and none have been refused operation. When I first began to operate I performed suprapubic cystotomy for nearly all large stones. Up to June, 1892, I had operated on 14 such cases, 11 by suprapubic cystotomy with 5 deaths, and 3 by lithotrity, all successful. Of the 36 similar cases operated since then, 32 were treated with lithotrity, 3 by laparotomy, and 1, complicated by stone in the ureter, required a special operation. The last 16 big stones have been removed by lithotrity and all successfully. I consider this result to be such a striking evidence in favour of lithotrity as a treatment for large stones that I have extracted the following small table of lithotrities from the general one.

TABLE III.—*Lithotrities performed for Large Stones.*

—		Total.	Age.			Weight in ounces.				
			0–29	30–59	60+	2·3	3·4	4·6	6·8	12
Lithotrity	Urethral ...	15	3	11	1	11	3	—	—	1
	Perineal ...	20	11	8	1	5	7	4	4	—

N.B.—All the 35 cases were cured without fistula.

It will be noted that in the tables above given the lithotrity cases are divided into two classes—urethral lithotrity and perineal lithotrity. By urethral lithotrity I mean Bigelow's operation; that is to say, the crushing of the stone and the removal of all the fragments at one sitting by instruments introduced through the entire urethra. By perineal lithotrity I mean the crushing of the stone by a lithoclast introduced into the bladder through a perineal incision and the removal of all the fragments through the same opening at one sitting. Bigelow's operation was performed in 15 of the 35 cases, and the more experience I have in this operation the more I am convinced that there are very few cases indeed which it cannot cope with. It is true that in the larger portion of the 35 cases I have performed the perineal operation. I have done so for one very sufficient reason. The operations are done before students and practically their only experience of stone operations is what they see me do. They will be called upon to operate on large stone cases, and for them and for the great majority of practitioners the perineal operation is by far the better. I therefore take frequent opportunities of demonstrating it to them. In the hands of a surgeon constantly operating, however, Bigelow's operation is practically capable of removing any stone however big. Very large stones have been successfully removed by it. Cunningham[2] records one of eight ounces, but even this has been surpassed by one of my recent cases, which I take the opportunity of recording here. The patient was an Egyptian fellah aged about forty-five years. The stone having been recognised as very big the largest lithotrite, having a gape of 5 inches (made to order for me by Messrs. Down Brothers), was introduced. After some difficulty the stone was grasped, the separation of the blades being to the extent of 4¾ inches. My whole force was necessary to crack the stone, and after a very tiring operation lasting 125 minutes the débris, amounting to 340 grammes, or over 12 ounces (dry weight), was entirely removed. The patient's convalescence was rapid and his cure complete. This is by far the largest stone I have ever crushed, and I believe it to be the biggest ever removed by Bigelow's operation. The stone was composed of urates and phosphates and was more than usually dense.

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[1] I have on another occasion (St. Thomas's Hospital Reports, London, 1891) referred to the extraordinary tolerance of Orientals to all operations and diseases connected with the urinary apparatus.

The result of Bigelow's operation for large stones has been excellent, fifteen cases over two ounces without a death, but at the same time it must be admitted that the execution of such operations is not facile. First as to the instruments required. The lithotrite to deal with large stones must be very powerful and at the same time such that the power can be discriminately and delicately applied. It must also be so constructed as to cause the least possible toil to the operator—a matter of great consideration in an operation lasting between one and two hours. I have always employed a modified Thompson's lithotrite. The modifications have been carried out for me by Messrs. Down Brothers, who have kindly expended great time and trouble in the work. They have produced for me instruments of the most excellent make and finish. I have seen and used lithotrites by many makers, English, American, German, French, and Italian, but have never come across any to compare with the ones they have lately made for me. The instruments I use for large stones are two. The first has a gape of two and a half inches; it measures fourteen English in the shaft and fifteen and a half at the shoulder. It is fully fenestrated and has a comparatively short beak. It has two modifications in the handle (Fig. 6). The wheel is much larger than usual; its diameter is two and a half inches and is made of aluminium for lightness. This increased size of the wheel adds very considerably to the pressure which can be exerted on the stone and also greatly increases the delicacy with which the pressure can be applied. The button which is generally employed to bring the screw action into play is replaced by a ring surrounding the handle. This ring runs very easily and it can be pressed on by the forefinger or thumb without altering the grasp on the handle, which is made a little longer than usual. I have never yet met the stone which this instrument has not been powerful enough to crush and I doubt very much whether such stones ever occur. I have had stones, however, too large to be seized in its grasp. I have therefore had made another lithotrite exactly similar in construction except that its gape (Fig. 7) is five inches—a gape sufficient for any stone ever yet met with. It was with this instrument that I crushed the stone of twelve ounces.

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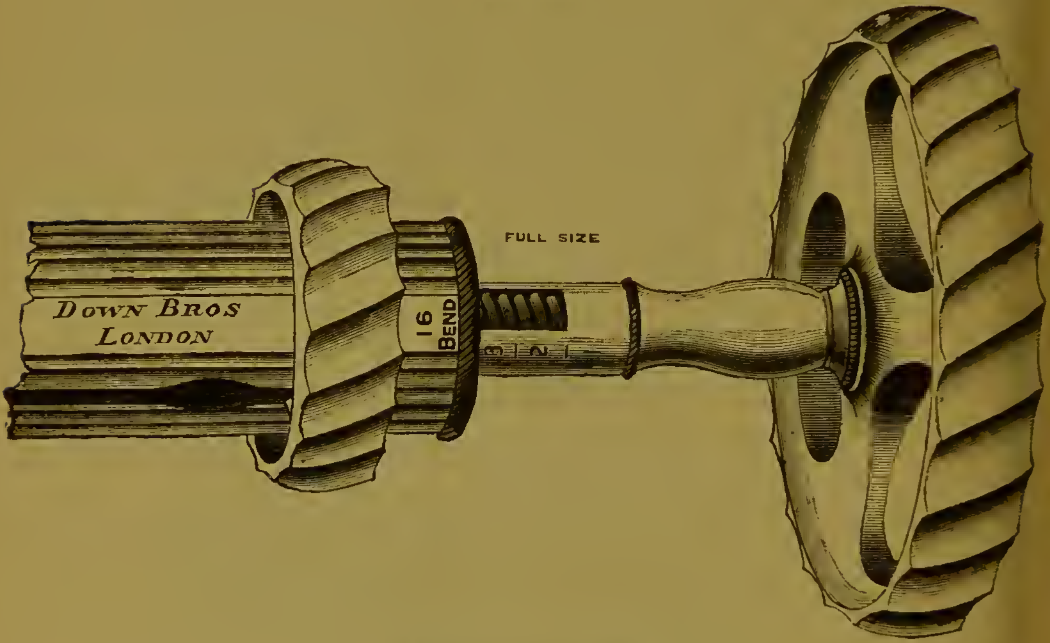
[2] Brit. Med. Jour., 1891, vol. i., p. 1008.

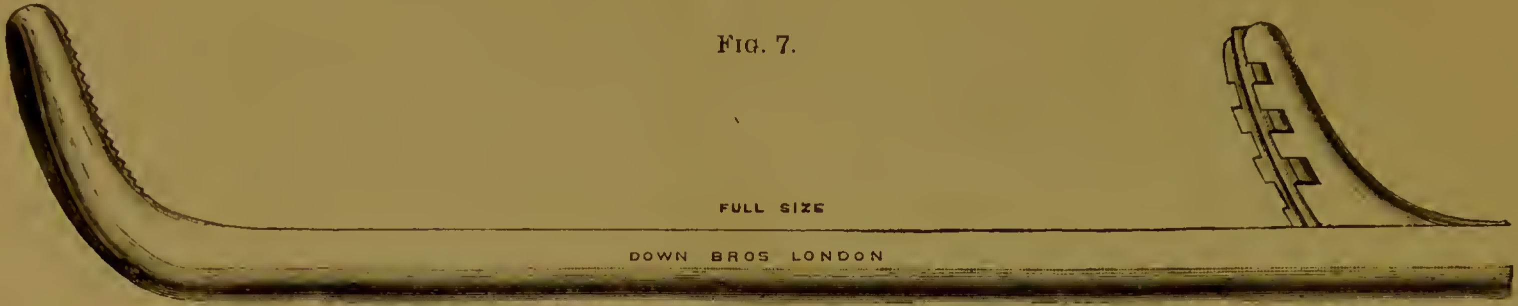
Fig. 6.



Handle of powerful lithotrite.

The evacuating tubes for operations on large stones should be straight and as large as possible. Egyptian patients have, I think, exceptionally large urethras, and I have frequently been able to introduce a No. 22 English, and I usually work with a No. 18 or 20. Of course, no force must be used in introducing a tube, but the largest should be used that can be introduced without violence. Secondly, as to the operator. There is no question that in order to crush a large stone well the operator must be in thorough condition and in constant practice, or, to use a sporting term, be in

Fig. 7.



Gape of powerful lithotrite.

'training." During the first twenty minutes of a long crushing most men can maintain the necessary delicacy of manipulation combined with the exercise of considerable force; but when it comes to working at the same strain for a second, third, fourth, or even fifth, sixth, or seventh period condition begins to tell. The force required to be exerted is often the full power of a strong wrist and arm even when using the powerful instruments I have described, and this force has to be exerted with great discrimination and great patience. Nothing, I think, can be sounder than the advice given by most experienced lithotritists to beginners not to crush big stones. I would, however, modify this advice to beginners thus: not to crush big stones except through a perineal incision. Given powerful instruments and an experienced operator the difficulties likely to be met with in crushing big stones are two. The first difficulty is in the seizure of the stone. This difficulty may arise from one of two causes—the size of the stone or the contraction on it of the bladder wall; very frequently the two are co-existent. With ordinary lithotrites the mere size of the stone may render it impossible to bring the screw power into action. Reference has been made in THE LANCET to a lithotrite built for an Indian surgeon to cope with such enormous stones. He had found on one occasion when grasping a large stone that the whole of the male screw projected beyond the handle of the lithotrite and that in consequence the screw action was completely out of gear. His remedy, devised on the spur of the moment, was excellent and was as forcible in execution as it was ancient in conception. He hammered the projecting extremity of the male blade until, after suffering considerable damage, it returned within the limits of the screw action. To meet an emergency the remedy was excellent, and to judge from the description the operator exhibited a perseverance which fell but little short of that of the French surgeon who early in this century only abandoned the attempt to fracture a stone by the same method after delivering a thousand blows. To construct a new instrument, however, to carry out this treatment was but to return to the percuteur of Baron Heurteloup, which was entirely superseded half a century ago by Weiss's screw action. The new instrument apparently embodies a percuteur as an addition to the screw action; it would seem to be much simpler to extend the screw, as has been done in my larger lithotrite, to the required dimensions. With this instrument any stone can be seized. The largest stone in my collection, weighing 34½ oz., comes easily within its grasp. It is hardly likely to come in contact with a larger one. The other cause of difficulty in seizing a large stone, the contraction on it of the bladder walls, is much more important. In my earlier operations I have on various occasions abandoned a lithotrity on this account. I have found that large stones are very frequently accompanied by extreme irritability of the bladder and partly from this cause and partly from the stone in some cases being large enough to occupy the whole bladder cavity the muscular walls are so contracted on it as to offer a very great resistance to the insinuation of the blades of the lithotrite. The force required for this insinuation is often such as to raise great apprehension in the mind of the operator as to the possible effects on the walls of the bladder. The danger of any serious injury is, however, in reality very slight, the bladder walls being often much thickened, and being in all cases very resistant to, and probably proof against, all steady movements of a blunt instrument within anything like reasonable limits. In such cases the distension of the bladder with fluid may be a great assistance, though it is often difficult of execution and, unless properly carried out, not devoid of danger.

Bladders have been ruptured by forcible injections during lithotrity and such cases have been recorded. In the overcoming of bladder resistance, however, time as well as force is an important element, and a long-continued slight pressure is as effectual as it is free from danger. In cases where there is considerable resistance and where distension is necessary I attach great importance to the use of continuous hydrostatic pressure. I pass into the bladder the largest size evacuating catheter that will easily enter, and after emptying and washing out the bladder I insert into the catheter the nozzle of an indiarubber tube one metre in length, terminating in a glass recipient, graduated in grammes and holding 1 kilo of boracic acid solution. The bore of the nozzle is 1 millimetre in diameter, so that the current can only enter the bladder very slowly, and every precaution is used to prevent the introduction of any large quantity of air. The recipient is now elevated 50 or 75 centimetres (20 to 30 inches) above the bladder level. In most cases 50 grammes or so of fluid enter the bladder at once, and the flow then either ceases or owing to the rejection by the bladder of the fluid introduced the level in the recipient rises again. Usually after a minute or two, and after various oscillations of level, 200 or 300 grammes of fluid, equal to about 8 to 12 ounces, enter the bladder. For an ordinary large stone this quantity is sufficient, but where dealing with a very large one I prefer to introduce, if possible, from 400 to 500 grammes. If necessary I maintain the pressure of 75 centimetres for five minutes, and then if the resistance is not yet overcome I raise the recipient one metre above the bladder level. This is nearly always sufficient after from three to five minutes, but in some rare cases I have had to increase the pressure to one metre and a quarter, which I consider, when all due precautions are taken, to be within the limits of safety, and at this level I have never met with failure. The presence of this considerable quantity of water in the bladder renders the seizure of the stone not only possible but with ordinary skill and patience easy. It must be remembered, also, that a stone has a smallest as well as a largest diameter. It often happens that a stone which when first seized is too big for the gape of the instrument may when grasped at another point come easily within the range of the screw action. It has been proposed by some operators to deal with such stones by gradually picking off fragments with the lithotrite until the mass is sufficiently diminished to allow of its being seized. This process is, however, of necessity slow, and I prefer to use an instrument with a sufficiently large gape. The second difficulty arises in the crushing. The resistance of the stone to the action of the instrument may be very great. It is due much more to the hardness of the stone than to its size, very large stones being frequently phosphatic in nature, soft, and friable. The most difficult stones to crack that I have come across have been between two or three ounces in weight. The oxalate of lime stone is, I think, the hardest of all, but I have met with stones composed chiefly of urates with a slight admixture of phosphates, which have been almost if not quite as resistant. For such stones the lithotrite must be strong and heavy and absolutely trustworthy, but with an instrument such as I use and have described above every stone may be crushed. They are not, however, to be crushed by simple force. The amount of pressure exerted by the jaws of the lithotrite is, of course, the principal factor, but, as in the dilatation of the bladder so here also, time has a very important influence. The experienced operator generally knows when he has before him a really hard stone. It has probably existed for some time and has grown very slowly. The urine is generally acid and contains little or no mucus or pus ; there is, in fact, no considerable cystitis. The sound gives out a ringing note and the stone usually moves freely about in the bladder. In the presence of such a case let him choose his strongest lithotrite. Having seized his stone, which is often a matter of difficulty, as many very hard stones are round and smooth, he will probably find that the male blade is sharply arrested with something like two inches of screw projecting from the handle. Directly he applies the screw force he will experience an abrupt resistance which all the strain he can or dare apply is unable to overcome. Let him wait half a minute and then put on an extra half or quarter turn ; if necessary let him repeat this wait and this extra pressure two or even three times, and the reward of his patience will almost certainly be the same as has always happened to myself. During one of these periods of waiting a sharp explosive crack will be heard and the difficulty of the case be over. A third difficulty in crushing a large stone arises from the amount of débris. I am convinced that in dealing with small stones the method adopted by Guyon is most excellent. He generally submits the stone to a very prolonged crushing before removing the lithotrite, occupying as much as twenty minutes in reducing the stone to the smallest possible fragments, and in many cases he continues the crushing until he has satisfied himself that all the fragments are small enough to pass through the evacuator. In this way the operation is completed with one or at most two introductions each of the lithotrite and of the evacuator, and much bruising and injury is spared to the urethra and prostate. In dealing with large stones I consider, however, that it is better to evacuate fragments frequently, and in such cases I stop crushing so soon as I feel my lithotrite impeded by the collection of many fragments and evacuate. In the early part of a prolonged operation I may remove my lithotrite after fifteen or sixteen crushes and evacuate, and I generally find that the procedure is thereby greatly facilitated. In removing, for instance, the twelve-ounce stone I must have introduced the evacuator at least six times before removing two ounces of débris; on the other hand, five or six evacuations sufficed to remove the other ten. I would give, then, a general rule as follows. When dealing with small stones endeavour to complete the fragmentation without removing the lithotrite, but in the case of large stones evacuate as soon as there is so much débris as to interfere with the free use of the lithotrite.

It will be gathered from the above remarks with regard to the suitability of Bigelow's operation as a treatment for large stones, that although the results obtainable may be excellent considerable practice is necessary before such results can be obtained. For the surgeon who only occasionally meets with stone cases I consider that there are other methods of operation more likely to meet with success, and of these other methods I should certainly give preference to that to which I have referred under the name of perineal lithotrity. There are various methods of performing this operation, but they all may be classified under three heads: (1) an incision is made into the urethra from the perineum and a strong lithotrite passed from this incision through the remainder of the urethra into the bladder; (2) an incision is made into the urethra from the perineum, the remainder of the urethra is stretched by some dilating instrument, and passage into the bladder thus given to a large stone crusher; and (3) an incision is made from the perineum into the bladder as in any one of the various classical operations for perineal lithotomy, and through this wound a stone crusher is introduced into the bladder. The first method has been recently practised and advocated by Keith.[3] He gives an excellent description of the operation and refers to very good results. I fail to see, however, what is gained by the procedure. The method is just as difficult as urethral lithotrity, if not more so, and it in no way increases the scope of the latter operation, which has been shown to be capable of removing stones much larger than any removed by Keith. I would limit its application to cases in which it is impossible to pass the lithotrite down the penile portion of the urethra. The second method was strongly advocated by Dolbeau, but in his hands and in those of other surgeons the results yielded have not been favourable. The method is very fully described in the French Medical Encyclopædias. The third method is the one I have chiefly practised myself and which I consider to be the best operation for large stones in the hands of the general surgeon. The method is referred to in most textbooks on surgery and is most generally condemned. As therein described, the perineal incision has been single, double, or multiple. Many forms of crushing instruments have been devised and unfortunately used. They have generally been most ingenious and more cumbersome. I have myself employed but one form for this operation, making a left lateral incision into the bladder and using a simple straight strong pair of forceps as a crusher (Fig. 8).

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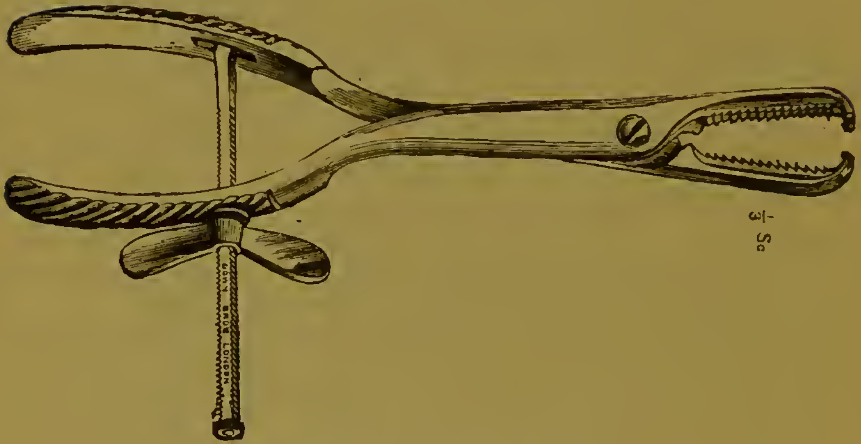
[3] Indian Medical Record, Calcutta, 1891, p. 521; also THE LANCET, June 4th and 11th, 1892.

Fig. 8.



Lithoclast for perineal lithotrity.

I will describe one of my operations, which will serve as a type for them all. The patient was an Egyptian fellah, male, aged fifty-four years, suffering from a large vesical calculus. The bladder was washed out with boracic acid solution and a laterally grooved staff introduced. The usual incision for lateral lithotomy was made into the bladder, the skin being freely divided, the prostate and neck of the bladder but slightly. The forefinger of the left hand was then inserted into the wound as the knife was withdrawn, and guided by the staff was insinuated in the bladder, dilating the wound in its progress. This method is in opposition to the directions usually given in text-books; I have, however, uniformly adopted it in all lateral lithotomies, of which, as shown in Table I.,[1] I have performed twenty-eight without a single death. My reasons for advocating this method are: (1) the diminution of the risk of hæmorrhage;

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[4] The Lancet April 18th, 1896.

(2) the exact limit thereby given to the wound in the neck of the bladder; and (3) the facility of the procedure. It must be observed, however, that all forefingers are not suitable for this purpose and that it is more difficult of execution and less advisable in the case of small children. Care must also be taken to insinuate the finger and not to use any violence to the neck of the bladder. In perineal lithotrity I have found this method particularly useful, as my crushing forceps coincide in diameter with my forefinger, and where the latter has been introduced they can easily follow. Having passed my finger fully into the bladder the staff was first withdrawn and then my finger. A careful examination of the incision having shown that there was no considerable hæmorrhage the crushing forceps, carefully oiled, were introduced through the wound on to the stone. Each handle of the forceps being held in one hand, the jaws were carefully opened, and, at the same time, their extremities were kept in careful apposition to the stone. There was, as is usually the case, some resistance to the opening of the forceps due to the stone being driven down to the neck of the bladder by muscular contraction. Graduated pressure on the forceps was sufficient to push the stone upwards and to thus free the jaws of the forceps from the constriction. The jaws, still in apposition with the stone, were then cautiously and easily opened until a large portion of the circumference of the stone was included in their grasp. The stone thus held was moved about in all directions and twisted through a quarter circle to ensure that no bladder wall was included. With ordinary care such an accident is almost impossible, and the difference in sensation as conducted by the forceps gives immediate and easily recognisable evidence should it occur. An endeavour was then made to crush the stone with the hand power only; but as this failed the screw action was applied with immediate success, the stone breaking with an audible report. One or two slight movements of the forceps sufficed to free the jaws of the crusher from fragments. The bladder was then carefully sounded with the closed forceps and a large fragment fixed upon. The forceps were again opened in the same cautious manner as before and this fragment crushed. This manœuvre was repeated three or four times until the amount of débris was such as to impede the crusher. This was then removed from the bladder, great care being taken to free its jaws from all fragments which might injure the wound during its extraction. These fragments might be detached either by movements of the forceps or with a thick blunt probe. The crusher being removed, the finger, carefully oiled, was introduced into the bladder, partly in order to recognise the existence of fragments small enough and partly to place them in the most favourable position for extraction. A very small pair of lithotomy forceps was then introduced into the bladder and fragment after fragment removed. Great care was taken to attempt the removal of no fragments so large as to be difficult of passage.

A repetition of these manœuvres of crushing and removal was sufficient to eventually entirely evacuate from the bladder a stone weighing 102 grammes or nearly 4 ounces. The bladder was then carefully washed out with a strong stream of water through the largest sized evacuating catheter. The whole of its walls were thoroughly explored by the finger and every fragment of stone removed. The operation lasted nearly thirty-five minutes. The patient left the hospital completely cured three weeks later. I have performed this operation on twenty occasions for large stones; of these, five weighed between 2 and 3 ounces, seven between 3 and 4 ounces, four between 4 and 6 ounces, and four between 6 and 8 ounces. Every one of these twenty operations was successful. The operation, therefore, has given me the most successful results. I consider it to be much easier of execution in such cases than ordinary lithotrity and to be much safer than suprapubic or other form of lithotomy. I would recommend it to the general operator as the best method of coping with large stones. The reproach has been made to this operation that it is likely to be followed by a perineal fistula. In my own practice this has so far not occurred, and if great care be taken to remove all fragments there is but little chance of its occurrence. I would at the same time recommend great attention to the following points:—(1) The crusher should be a simple, powerful straight forceps, a little less in diameter when closed than the operator's forefinger, and should have a simple screw attachment; (2) the wound into the bladder should be only of such size as to admit the forefinger; (3) everything introduced into the bladder should be freely lubricated; (4) the extremities of the jaws of the forceps should be kept touching the fragment about to be seized, and every care taken to avoid seizure of the mucous membrane; (5) the greatest gentleness should be exercised in all movements; (6) no fragments should be removed by means of the crusher; (7) no attempt should be made to remove any fragments except such as can pass with complete ease; (8) the forefinger should be continually used to explore the condition of the bladder and the position of the fragments; (9) the greatest care should be taken to leave no fragments behind; and (10) complete cleanliness is absolutely essential.

I formulate the above axioms only after great consideration, inasmuch as they differ somewhat from the teaching of Reginald Harrison, who has done more than anyone to establish perineal lithotrity. He first brought his method before the profession in 1888, and up to May, 1895, had performed 15 operations all successfully.[5] He prefers to make an incision into the urethra only, and to introduce through this opening a crushing forceps into the bladder, the crusher having about the diameter of a forefinger. My experience has been that a forefinger cannot be introduced without laceration of the tissues about the neck of the bladder, and I prefer to determine the direction of this laceration downwards and outwards by a small incision rather than to leave it to chance. He utilises also the crusher to remove fragments, supplementing this instrument by washing out the bladder with an evacuating syringe. For myself I am convinced that the removal of fragments by an instrument which when closed equals in size the original opening cannot but be attended with laceration or bruising of that opening, and I think greater safety is obtained by using the crusher for crushing only and by removing fragments with a fine pair of forceps or with a spoon. I consider also that the difficulty which certainly exists in this operation of entirely removing every fragment necessitates a thorough digital exploration of the bladder. This cannot, I think, be effectually done through an incision into the urethra only. In principle, however, the operation recommended by Harrison in 1888 is identical with that which I have, following his indications, found so useful. His results also have been more favourable than mine, he having performed fifteen cases without a death, whereas I out of twenty-seven have lost one. With regard, therefore, to the treatment of the first complication of cases of stone, I am of opinion that the results obtainable by lithotrity are better than those which have been obtained by any other form of operation on stones exceptional for their size and hardness. I consider that practically every bladder stone uncomplicated, except with regard to its size and its hardness, can be removed by one of the two forms of lithotrity above described. The proportion of such cases suitable for the one operation or the other will depend on the experience of the operator. Bigelow's operation I consider to be the more brilliant, perineal lithotrity the more generally useful. The indication for the latter operation increases with the size of the stone and diminishes with the experience of the operator.

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[5] Vide reprint of a lecture on Some Points in the Practice of Lithotrity and Litholapaxy, John Bale and Sons, London, 1895.

The next complications to which I have to refer are those arising from the position of the stone. Leaving out of consideration stones entirely outside the bladder cavity, the abnormal positions that I have had to deal with are four: (1) the stone has been partly in the bladder and partly in the ureter; (2) the stone has been lodged entirely or partly in a diverticulum of the bladder; (3) the stone has been lodged in a deep pouch behind the prostate; and (4) the stone has been partly in the bladder and partly in the urethra.

1. *Where the stone has been partly in the bladder and partly in the ureter.*—I have met with and diagnosed during operation three cases of this somewhat rare condition. In all of them there was in addition a stone entirely in the bladder cavity, and it was only on the removal of the bladder stone that the one impacted in the ureter was detected.

Quite lately I have met with a case in which the only stone present was impacted at the opening of the right ureter. This case was diagnosed before operation, and supra-pubic cystotomy was performed for the removal of the stone. The first case I met with is worth recording. The patient was a healthy Egyptian fellah aged about fifty years. A largish stone had been diagnosed and I performed lithotrity. After removing some 60 grammes of débris, and after the evacuator had long ceased to remove any fragments, I could still feel and hear a stone on sounding. Repeated attempts to seize this with the lithotrite failed entirely. The stone, as felt by the sound, always occupied the same position on the right side of the base of the bladder. My suspicions being aroused I examined per rectum and felt a distinct, immovable, hard mass which I could balance between my finger and the sound. The position corresponded exactly to the point of entry of the right ureter into the bladder and the diagnosis was thus established. After much consideration I decided to attempt its removal and proceeded to open the bladder by a perineal incision. A supra-pubic opening would probably have been wiser, but the stone as felt per rectum seemed quite close at hand to the perineum. A finger introduced into the bladder easily recognised the stone, which after some difficulty I managed to seize with a lithotomy forceps. All traction, however, failed to move it. I proceeded to incise the opening of the ureter into the bladder, passing a long knife with a rounded cutting extremity along my forefinger on to the stone. After much difficulty I sufficiently liberated the stone to allow of its removal. The stone was an inch and two lines in length and nearly two inches in circumference. There was a very marked neck or construction corresponding to the orifice of the ureter; the part beyond this, about a sixth of the whole stone, had projected into the bladder; the other five-sixths had been retained in the ureter. The result of this operation was unsatisfactory, the patient dying some twenty days after the operation. Post mortem there were found very marked old kidney degenerations and a sub-peritoneal abscess around the right ureteral opening. This case is mentioned in the tables under the heading "Other." In my second case the diagnosis was made in exactly the same way as in the one above described. I decided, however, that if I could not seize the stone with my lithotrite I would let it be. After many fruitless essays I at last grasped it by pushing the stone up to the lithotrite with a finger introduced into the rectum. The stone remained at first immovable from its position, and during an extra strong effort the grasp of the lithotrite slipped. I was able, however, to grasp the stone again and after several trials succeeded in drawing it out of the ureter. Its subsequent crushing presented no difficulty and the case recovered perfectly. In my third case the diagnosis, treatment, and result were the same as in No. 2. In this case, however, I kept the débris of the two stones quite separate.

The bladder stone weighed 19 grammes and consisted of urates and oxalates; the ureter stone weighed 3 grammes and consisted of oxalates, urates, and carbonates. This condition is more common than is usually recognised, many cases having perhaps been diagnosed as stone in a diverticulum of the bladder. A most interesting case is recorded by E. H. Fenwick[6] of a double stone, one part of which is described as being in the bladder and the other in a diverticulum outside the base and back of the bladder. The very difficult operation for its removal was successful, and no more exact determination was therefore possible, but the condition so closely resembles that of my first case, in which the diagnosis was unfortunately confirmed by a necropsy, that I strongly suspect that in Fenwick's case also the stone was lodged in the dilated ureter. The same remark applies to a case reported by McArdle,[7] to one reported by T. V. Jackson to the Pathological Society of London, and to one at least of the cases described by Bruce Clarke in his paper on Latent Calculi.[8] Thomas Smith records a case.[9] Buckston Browne records a probable and Pitts a certain case in the Transactions of the Clinical Society of London, 1890, p. 89. At the same meeting Freyer described a stone partly in the bladder and partly in the ureter which was successfully removed at the second operation. Buckston Browne refers to another case in the Transactions of the Clinical Society of London, 1889, p. 36. The above records show that the condition is sufficiently frequent to be of a real importance, and I consider that in all operations for bladder stone the orifices of the two ureters should be carefully examined. Further, I think it of special importance to thoroughly examine this region in cases in which stone has been suspected and not found. The examination, to be effectual, must be bimanual. The forefinger of the left hand should be introduced into the rectum and should thoroughly explore the base of the bladder. The same region should at the same time be explored by a sound introduced into the bladder per urethram. Frequently this examination cannot be satisfactorily carried out except under chloroform, but if properly performed the presence of a stone partly in the ureter may be rendered either certain or very probable. Having detected a stone in this condition how should it be treated? In my opinion a through trial should be given to lithotrity. A small, light lithotrite should be used, the position of the protruding part of the stone carefully determined, and an attempt (to be repeated many times if necessary) made to seize it. The stone having been grasped by the lithotrite, half a turn of the screw should be given to tighten the grip and attempts be made to pull the stone into the general bladder cavity. Great assistance, both in seizing and dislodging the stone, may be given by a finger in the rectum. Should it be possible to grasp the stone but not to dislodge it I should not attempt to crush it *in situ*, there being too great a risk of crushing surrounding tissue at the same time. Having given a fair trial to lithotrity, and having failed, I should at once perform supra-pubic cystotomy, enlarge the orifice of the ureter by careful dilatation or by several small incisions, and, if necessary, break up the stone with a small pair of necrosis forceps. The result of my operations for this condition has not been good. I have operated in all four times (once since commencing this paper), with a mortality of 2, or 50 per cent. The two successful cases were lithotrities. In the two fatal cases lithotrity failed, in the one I did lateral and in the other supra-pubic cystotomy.

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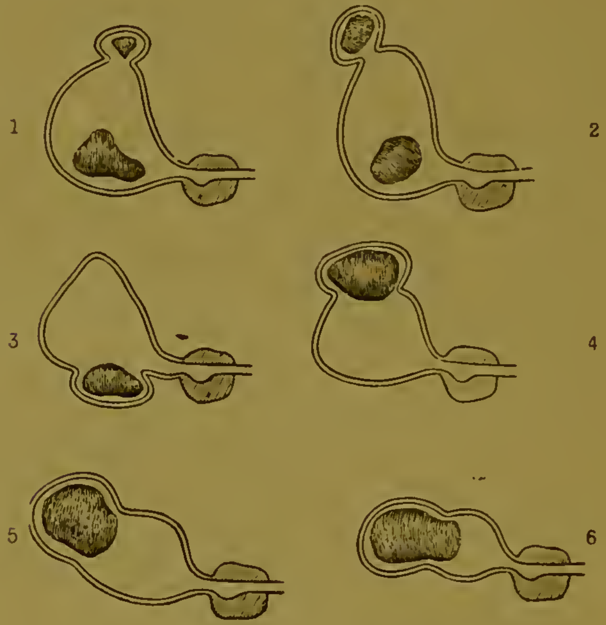
[6] Brit. Med. Jour., Nov. 17th, 1888.

[7] Transactions of the Royal Academy of Medicine, Dublin, 1890, p 170.

[8] St. Bartholomew's Hospital Reports, 1891, p. 117.

[9] Transactions of the Pathological Society, vol. xiv., p. 185.

Fig. 9.

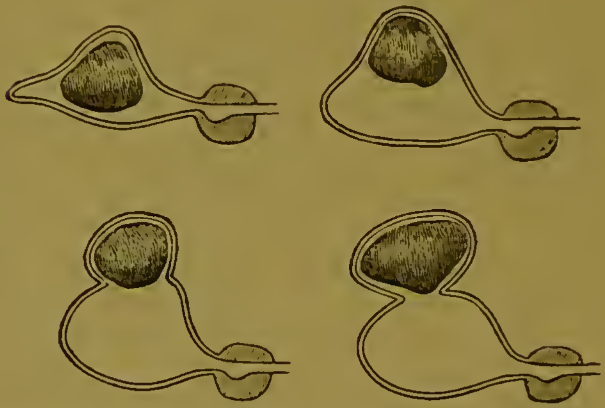


Examples of encysted stones. (Semi-diagrammatic.)

2. *Where the stone has been lodged in a diverticulum of the bladder.*—I have met with six cases in which I have been able to diagnose the position of the stone in a sac communicating by a large or small opening with the bladder cavity. I have met with two others in which the condition, though certain, had not yet reached an advanced stage, and several cases in which the stone, though not encysted, always occupied a special portion of the general cavity. Of the six cases of complete sacculation (Fig. 9) Nos. 1, 3, and 4 were operated

on successfully by urethral lithotrity and Nos. 2, 5, and 6 by perineal lithotrity—two successfully and one, No. 2, with a fatal result. The first case caused me for a time great anxiety. The condition had not been recognised before operation and the stone had been easily seized and crushed. The débris was passing freely through the evacuator, where I noticed a curious gurgling sound, and on inspecting the abdomen perceived that each injection of water into the bladder produced a swelling evidently outside the bladder cavity. I suspected at once that I had during my manipulations perforated the bladder wall. The extravasation of water seemed, however, so limited that I determined to thoroughly explore with a sound before proceeding to cut down on to the perforation. I managed to introduce the sound into the extravasation, and after careful exploration convinced myself, to my intense relief, that I had to deal with a diverticulum of the bladder. I recognised a stone in the diverticulum, but cannot say whether it was originally there or was a fragment which had been washed up. I introduced a small lithotrite into the sac and crushed the stone, the fragments falling into the general bladder cavity. The patient recovered perfectly. The second case is of importance from many points: (1) the almost complete closure of the sac; (2) the erroneous diagnosis; and (3) the fatal result. The patient was an Egyptian fellah aged about eighty five years, suffering from a stone in the bladder with very fœtid cystitis, and his general condition was unsatisfactory. I tried to perform urethral lithotrity, but failed to grasp the stone, the movements of the lithotrite being impeded by a tumour which could easily be balanced between the lithotrite in the bladder and a hand on the abdominal wall. Considering the age of the patient, the fœtid cystitis, and general debility I surmised the existence of a bladder growth, probably malignant. I made a perineal incision, crushed the stone, and removed it. I then introduced my finger into the bladder and thoroughly examined the tumour. Its surface was rough and fragments were easily detachable, and I therefore considered my diagnosis of malignant tumour fully confirmed. The patient died a few days later, partly from exhaustion and partly from septicæmia. On post-mortem examination the tumour situated at the summit of the bladder turned out to be a stone enclosed in a sac communicating with the general bladder cavity by a tiny passage through which a probe could only be passed with great difficulty. The whole cavity of the bladder was lined with pendulous granulations due to the presence of innumerable bilharzia embryos. In this case the communication between the sac and the bladder was so minute that the stone could not have been reached by any operation from the bladder cavity. Had an exact diagnosis been possible a supra-pubic operation with incision through the peritoneum into the cyst might have been attempted. Under the circumstances, however, it is doubtful whether the ultimate result would have been different. The third case was diagnosed before the lithotrite was introduced. I am, however, in doubt as to whether this was not a case of stone in the right ureter. On introducing the lithotrite I found, as I had found when sounding, that the stone could not be felt until I had reversed the lithotrite and insinuated its extremities into a cavity situated behind the prostate and to the right of the middle line. A finger in the rectum was sufficient to clearly differentiate the limits of the sac and to distinguish it by its position from a post-prostatic pouch. Having guided the jaws of the lithotrite into the cavity of the sac, and carefully controlling every movement by a finger in the rectum, I was able to seize and crush the stone, and after a somewhat prolonged and difficult operation I succeeded in removing all the débris through a curved evacuator. The fourth case was easily treated by urethral lithotrity, the communication being very free between the two cavities. The condition was easily recognised (1) by the position of the stone, (2) by the result of bimanual examination, (3) by the contour of the bladder when distended with water, and (4) by a careful examination of the cavity of the bladder with a sound after operation. The fifth and sixth cases were treated by perineal lithotrity and the condition easily recognised by the finger introduced into the bladder. In both I had tried urethral lithotrity and had failed. The sixth case was particularly interesting. The patient was a boy aged about fourteen years in whom a large stone had been diagnosed. Repeated attempts to grasp the stone with a lithotrite were in vain and I opened the bladder by a lateral perineal incision. The forefinger introduced into the wound entered a large cavity distended with urine. Behind this could be recognised the stone tightly grasped by the bladder. After great difficulty this was seized and crushed and the débris removed. Digital examination then showed that the bladder was divided by an annular constriction into two cavities, anterior and posterior, of nearly equal size. The lower part of this annular constriction stretched from the opening of one ureter to that of the other. The front cavity, therefore, coincided with the trigonal pouch largely dilated; the hinder cavity represented the rest of the bladder. The origin, or rather one possible mode of origin of these diverticula, suggested itself to me in meeting with some of their earlier manifestations. I have seen, as above stated, cases of what I consider to be the first stage of the encapsulating process. This condition is indicated by the stone always occupying a special portion of the bladder cavity. It has frequently happened to me in performing lithotrity to find the position occupied by the stone evidently not depending on gravity. I know of no stone lighter than urine, yet I have often found that a stone was to be felt only at the summit of the bladder, perhaps at the very highest point of that viscus, perhaps a little to one side or the other. In all these cases the stone has always retained the same position, and in most of them I have met with difficulty in grasping the stone with a lithotrite. For some time I failed to see the explanation of this condition until a case occurred in which, having after many attempts failed to grasp the stone, I proceeded to a perineal section. On introducing the forefinger I found that the stone was fixed in its abnormal position by the grasp on it of the muscular walls of the bladder, and it was only with great difficulty that I succeeded in displacing it. Once displaced it fell to the base of the bladder and I crushed and removed it easily. After the removal of the débris I thoroughly examined the bladder bimanually and could find no trace of any cystic formation ; the walls presented, moreover, no irregularity or constriction of any kind. Some months later I came across a case (No. 136 on my list) in which a very similar condition existed, with this difference, however, that after the removal of the stone there still remained an evident, though apparently muscular, constriction producing a distinct irregularity in the shape of the bladder cavity. This I consider to have been a slightly later stage of the same condition as existed in the previous case. I consider, also, the sixth case of sacculated bladder to have been a still further development of the same condition, and so on through the other cases up to No. 2, in which the sac had been almost entirely closed off. I attach the principal importance in the production of encysted stone to the contraction on it of the muscular walls of the bladder. I would sketch the history of such a case as follows. The beginning of the story is probably the descent of the stone into the bladder. There it gradually increases in size, producing more or less of the usual symptoms attendant on stone. The bladder becomes irritated and its contractions excessive. For some reason, perhaps during sleep, when the stone probably rests in one place, the muscular contraction becomes such as to grasp the stone. This contraction may be spasmodic or continuous. In the latter case, after a certain time the continuous contraction will gradually tend not only to grasp but to envelop the stone. Those portions of the bladder walls which lie immediately beyond the stone, finding no resistance except their own rigidity, will gradually form an annular constriction, dividing the bladder into two cavities, one of which is occupied by the stone. (Fig. 10.) This muscular action, if continued long enough, and especially when assisted by inflammatory deposits and their secondary contraction, is, I consider, quite sufficient to convert the cavity into a sac communicating by only a small or very small opening with the bladder cavity. It is quite comprehensible even that this opening might become completely closed. I think that there are certainly, therefore, two methods at least by which an encysted stone may be produced—the first is by retention of the stone in the ureter and the second by muscular and cicatricial contraction on it of the bladder walls. The first method has been certainly demonstrated by the discovery of stones in the ureter as it pierces the bladder walls. The second method is rendered very probable (1) by its physiological possibility; (2) by the various stages observed in the cases quoted above; (3) by the fact that nearly all encysted stones fill the cyst they occupy; and (4) by the fact that while sacculated bladders from distension are common, cysts are very uncommon except in connexion with stone. The sixth case of encysted stone is particularly interesting on account of the position of the constriction. The lower part of the ring coincided exactly with the strong transverse band of muscular fibres stretching across the base of the trigone from one ureter to the other. The contraction of this band was in all probability the commencement of the encysting process, which extended later so as to completely surround the stone and to produce a double bladder cavity. I have examined many large stones, two in my collection, one of 36¼ oz. and one of 14 oz., one in the collection of Norwich Hospital (a cast), and several in the collection of the Royal College of Surgeons of England, and I have found on the under surface of nearly all of them a groove produced, I think, by the contraction of this transverse muscular band. I think that in many cases the portion of the bladder cavity behind this band contains the greater part of the stone, the portion in front of it forming the imperfectly acting urinary reservoir. This contraction of the muscular coat of the bladder on the stone is, I think, therefore, a great agent in producing a condition of encystment. It is at the same time the means of producing considerable alleviation in the symptoms due to the stone, inasmuch as it largely limits its movements. It has therefore the appearance of being an attempted cure, or rather

FIG. 10.



Showing process of encapsulation from muscular contraction. (Diagrammatic.)

alleviation, on the part of nature, and helps to explain the prolonged periods for which large stones have been patiently carried by their unfortunate possessors.

3. *Where the stone has been lodged in a retro-prostatic pouch.*—In Egypt prostatic disease is of very rare occurrence, and the number of cases of stone complicated in this way has not in my experience been great. The condition when met with also has been due much more to pouching of the bladder than to an enlargement of the prostate. The pouch in consequence is always largely open and the difficulties presented by it comparatively slight. In fact, I consider that a post-prostatic pouch when largely open is rather a help than a hinderance to the detection of the stone and to the performance both of lithotrity and lithotomy. With regard to detection, if it is made a routine practice to search the post-prostatic pouch it becomes the easiest place to find a stone. In lithotrity the pouch lies open in the most favourable condition for receiving fragments and forms a happy hunting ground for the reversed beak of the lithotrite. In lithotomy the pouch forms a swelling which the knife of the veriest tyro cannot miss. A pouch of this description presents, however, a complication under two conditions. Firstly, it is apt to retain tiny fragments even after very careful washing out. I have found that this may usually be avoided by using a slightly curved evacuator the beak of which is reversed into the sac. Careful washing out, injecting only very small quantities of water very slowly so as not to displace the fragments, is, when combined with equally careful searchings with the reversed sound, almost certainly successful. Secondly, it is apt to retain residual urine during convalescence. For this the simplest treatment is to make the patient pass urine while lying on his abdomen. Should cystitis ensue the bladder must be carefully washed out.

4. *Where the stone has been lodged partly in the urethra and partly in the bladder.*—This condition is uncommon and as a rule presents but little extra difficulty as regards treatment. The symptoms which may lead to a suspicion of the existence of this condition are two: (1) great increase of pain after micturition from contraction of the neck of the bladder on the stone, and (2) complete mechanical obstruction to the passage of any urine. The diagnosis is easily made on passing the sound; the only condition likely to be mistaken for it is the existence of a stone in the prostatic urethra. The treatment in both cases is the same. An attempt should be made to push back the stone into the bladder cavity. This is usually best accomplished by means of a large, straight evacuating tube which, guided and assisted by a finger in the rectum, is made to displace the stone from the depression or dilatation in which it is buried and to push it onwards. No great force must be used in these manœuvres, and should they fail a perineal incision should be immediately practised on to the stone.

There are of course various other positions which may be taken up by urinary calculus. In addition to the usual situations occupied by stones in the kidneys, ureters, prostate, urethra, prepuce, and scrotum, they have occasionally been met with partly or entirely outside the urinary organs. Such cases, however, do not come under the category of bladder stones, to which alone my observations refer, and I shall leave them out of consideration. The question to be decided, therefore, is, given that a stone has been recognised as encysted either by partial retention in the ureter, by sacculation of the bladder, or by a post-prostatic cyst, which is the best method of treatment? With regard to a stone partially retained by the ureter I have already expressed my opinion. When the stone is situated in a sacculus or diverticulum of the bladder the method of treatment should depend chiefly on the relative or actual size of the mouth of the sac. Or assuming the sac to be produced by muscular action, I would state my opinion in this way, that the method of treatment should depend on the stage of development of the sac. In the very earliest stages—viz., in those in which the stone is simply grasped by the contraction of a portion of the muscular walls—urethral lithotrity is plainly indicated. The only difficulty is in getting the first grasp of the stone. This difficulty may as a rule be easily overcome by distending the bladder with water. I have already referred to the methods I employ when crushing a large stone on which the whole bladder is firmly contracted. The conditions existing in the first stage of encystment of a stone are very much the same and the graduated pressure of the hydrostatic douche is equally efficient. After the introduction of a few hundred grammes of water the muscular contraction gives way and the stone drops to the bottom of the bladder either by itself or with slight help from the sound. When the process has arrived at a later stage and there is a definite permanent constriction of the bladder cavity, distension with water is of little avail. If the opening into the sac be large—say, equal in diameter to two-thirds of the diameter of the stone—and if the stone moves freely in the sac, an attempt may be made to perform urethral lithotrity. Such an operation must, however, be conducted with the greatest care and patience. That it is possible is shown by the success of the three cases (Nos. 1, 3, and 4) in which it was performed. It is, however, an operation which should only be attempted by a lithotritist in constant practice. Failing urethral lithotrity, the selection seems to be between perineal lithotrity and suprapubic lithotomy, and I think that each operation is fitted for a separate class of case. Those cases which seem suitable for urethral lithotrity from the largeness of the mouth of the sac, but in which this operation cannot be carried out, may, I think, be treated with a good prospect of success by perineal lithotrity. Those cases which, from the smallness of the opening, are evidently unfitted for urethral lithotrity are equally unfitted for the perineal operation and should, if they are interfered with at all, be treated by suprapubic cystotomy.

With regard to stones retained in a post-prostatic pouch my experience has been, in the few cases I have had, that urethral lithotrity was very easily performed and afforded successful results. In the more advanced cases referred to by Buckstone Browne I see no alternative but suprapubic cystotomy. The third category of complications are those arising from the incomplete development of infancy and childhood; in other words, from the smallness of the parts concerned. My personal experience of stone in children has been but small. In Egypt the very great majority of stones occur in subjects over ten years of age. The tables given with this paper do not demonstrate this point, but on reference to my records I find that out of the 200 cases given in Table I. 9 only were in children under ten, whereas Cheselden in 213 cases met with 105. In India, on the other hand, the proportion of children operated on is exceptionally large. The difference is due to the fact that stone in Egypt is principally caused by the alterations produced in the urinary system by the presence of Bilharzia embryos, and that the Bilharzia parasite, while very common in adult males, is rare in women and children. The relative values of the various operations for children have been frequently discussed of late years in the medical journals. The Indian surgeons especially, following the example of Keegan and Freyer, have published many records and have very strongly advocated lithotrity for children of all ages. The results they have obtained have been remarkably good and equal—at least, the best results given by lithotomy. While, however, it must be accepted that the method is an excellent one as practised by experts, it is by no means certain that the general surgeon will find its adoption satisfactory. The conclusion I have come to is that when a surgeon is likely to have to treat many cases of stone in children it will be advisable for him to acquire the necessary ability that practice only can give, but that the surgeon called upon to treat such cases occasionally only will do better by keeping to the time-honoured operation of Cheselden. I have quite lately come across very useful information on this head in a paper by Gilbert Barling.[10] In it are given the results of 152 operations performed in various English hospitals between 1888 and 1892 on children under ten years of age. Of these, 43 were litholapaxy with 1 death, 46 were suprapubic lithotomies with 10 deaths, 48 were lateral lithotomies with 2 deaths, and 15 were median lithotomies with 1 death. These figures, giving the experience of many surgeons, represent, I think, the relative values of the different operations more fairly than the results obtained at the hands of a few specialists. It fully bears out what has been my opinion for long past that the results obtained by suprapubic operation in children are far from justifying the preference given to it in some quarters. Any considerable statistical evidence in its favour is still wanting.

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[10] Brit. Med. Jour., March 9th, 1895.

and this while statistics, to be counted by many hundreds, have been published by various operators showing a mortality of greatly under 5 per cent. for litholapaxy and perineal lithotomy. The fourth category of complications are those arising from old age and its degenerations, and it is in avoiding the dangers due to these complications that the most real difficulties of the surgeon lie. To-day, thanks to the great improvements in instruments and methods, and especially to the cleanliness so universally practised, the mortality rate of stone operations in children and adults is, at the hands of experts, almost *nil* or, as it might perhaps be expressed, it is reduced to the personal equation of the operator. When once the true percentage mortality of an operation or class of operations has been brought down to zero by any operator, as it has been done by more than one surgeon in India, in the case of stone, it is hardly justifiable to talk of the dangers inherent to the operation. I advisedly use the term true percentage mortality, being of the opinion that no percentage mortality can pretend to truth, and, therefore, should not be estimated until the number of cases cited can be counted by centuries. It is unjustifiable to calculate a percentage mortality from 99 cases as from one case, and I would express proportions deduced from such numbers as relative mortalities, taking for expression of the ratios the lowest possible whole numbers, thus 1 in 15 or 2 in 31. While, however, the percentage mortality of stone operations has been reduced almost to *nil* in adults and children, the results are quite otherwise when dealing with the aged. Old subjects support most operations fairly well, amputations are constantly successfully performed in extreme old age, and ovariotomy in very old women is almost as successful as amongst the young. Shock, if great care is taken to prevent loss of heat, is probably less marked in the old than in the young after operative interference. Old tissues, so long as elimination of effete products is fairly carried out, are probably not such suitable media for the development of most micro-organisms as the juicier tissues of the young. While, however, the susceptibility to attack is perhaps diminished, the power of expulsion of morbid products is generally greatly lowered. In youth and middle age the individual can assimilate most things, from the living organisms of various diseases to the toxines of lobster salad, with certain trust in his powers of elimination. In old age, while the resistance to attack by living organisms is perhaps greater, the powers of elimination are probably much diminished. The epithelial surfaces from their increased dryness and rigidity are perhaps more efficiently protective than when in a younger stage, but their power of excretion is proportionately enfeebled. It is probable that a preponderant share of the work of elimination is in old subjects carried on by the kidneys, and any morbid condition of the urinary apparatus has therefore a special importance. It is, moreover, in connexion with the urinary system that occur the local complications usually attending stone in old men. Chronic gouty or other changes in the kidney, atony of the bladder and cystitis, obstructive enlargement of the prostate, are often the accompaniments if not the original cause of the calculus. An old man the subject of such morbid conditions is already in a perilous condition, and the scales of life and death begin to balance. A slight addition to either means its preponderance, but the result is likely to be in the one case only temporary and in the other permanent. The first question that arises, therefore, is whether under any conditions any attempt should be made to remove the stone or not. It is difficult to adduce any evidence on this point. There are many statistics showing the mortalities of stone operations in the aged, but I know of none showing what percentage of the cases met with had been operated on. The mortality attending any form of stone operation under the conditions mentioned must be high, and, on the other hand, the inconvenience produced by the stone is under such circumstances, as has been pointed out by Sir Henry Thompson, not unfrequently comparatively slight. Further, even in what are reckoned in statistical returns as successful cases the amount of relief after operation may be but slight. I think, however, the general opinion of the profession, and more especially of operators, is that relief should be attempted in practically all cases except those in which the condition of the patient is such as to contra-indicate all interference from fear of immediate death.

Having decided on operating, the question still lies as to which method should be pursued. Here I think there is but little doubt. Opinion is universally in favour of the crushing operation. In the paper above referred to 155 of the cases were in subjects aged over sixty years. Of these 118 were operated on by litholapaxy, with a mortality of 11, equal to about 9·2 per cent ; 26 by suprapubic lithotomy, with a mortality of 8, equal to very nearly 1 in 3 ; and 11 by perineal lithotomy, with a mortality of 2. Of course, in these as in other statistics the relative mortality of the operations may depend on other factors than their intrinsic merits, but the table is particularly valuable as showing the great preference accorded by surgeons in general to the crushing process in the treatment of stone in the aged. Still, even by this the most favourable method the mortality is very considerable. I am inclined to attribute the dangers of lithotrity in old men to two principal factors—firstly, the bruising of the urethra, neck of the bladder, and prostate by the frequent introduction of the instruments ; and secondly, to the effect on a weak bladder of over-distension during the evacuating process. I think that anything which tends to diminish these two dangers would largely increase the advantages of lithotrity. I have sought to obviate the first factor by uniting the crusher and evacuator in a single instrument—the evacuating lithotrite referred to previously. I have alluded to the use of this instrument in simple stone cases, but it is in the treatment of the class of complications now under notice that its chief use is likely to be found. My experience of it is not yet sufficiently large to express any opinion of its value, but I think that it is worthy of trial. In order to obtain success in this as in other forms of stone operations in similar cases attention is necessary to the minutest details. The patient should be kept in bed for at least two days before operation; he should be kept on a regular nourishing diet suitable to his general condition. Milk should if possible be taken in quantity. The bowels should be gently opened on each of the two days by saline purge and enema. Any catheterisation that is necessary may be carried out, but I think that the more the urethra and bladder are left alone the better. I consider it to be a good routine practice to give from fifteen to twenty grains of diuretin twice daily during the two days. I think that this drug is very useful for washing and cleaning out the urinary and general system and is an excellent general stimulant. A good night's rest should if possible be obtained before the operation, which I think is best performed as early in the morning as is consistent with the comfort of the patient. During the operation the greatest care must be taken to avoid any loss of heat. The room must be well warmed and the patient, especially his extremities, well covered. Eggs, milk, and stimulants should be taken from one to two hours previously. The question of anæsthesia is very important. Ether is, I think, in such cases often dangerous from its possible after-effects. Chloroform is preferable, although not free from danger: of other general anæsthetics I have no experience. I believe, however, that the use of an instrument capable of terminating the operation with a single introduction will obviate to a great extent the necessity for an anæsthetic. I have experimented with various drugs locally, but as yet without great success. Cocaine as an injection is, I think, too dangerous. Antipyrin in a 5 per cent. solution diminishes sensation considerably. Methylene blue in a 5 per cent. solution is even more effectual, but still does not sufficiently abolish sensibility. Up to the present I prefer to use chloroform narcosis, but I have found that a very small quantity of the drug is sufficient.

It is very important to use the largest instrument that can be introduced without putting any undue strain on the urethra. If small instruments be used the fragments extracted must of necessity be small and the operation in consequence prolonged. A fair idea of the capacity of the urethra may be gained from the size of its orifice. In most cases a No. 16 evacuating lithotrite may be used; in many, however, a No. 14 is the largest which can be easily introduced. The instrument must be well oiled and warmed and introduced with the minutest care. The point of the lithotrite having been introduced into the orifice should be allowed to find its own way down to the membranous portion of the urethra. The weight of the instrument is quite enough to effect this, and the left hand of the operator should only be used to keep it first horizontally and then perpendicularly in the middle line. During this passage the urethra must be put at its full stretch by pulling the penis vertically upwards with the right hand. There is a tendency for the lithotrite to be arrested on entering the membranous urethra, and it is here that the skill of the practised operator is required to ensure an uninterrupted, regular passage into the bladder. The moment before this arrest would take place the right hand of the surgeon leaves the extended penis and applies through the medium of the second and third fingers a pressure to the heel of the lithotrite. This, accompanied by the gradual depression of the handle between the legs of the patient, carries the jaws of the instrument smoothly through the membranous constriction, over the ridge of the prostate, and into the cavity of the bladder. It is during this moment, and at this time only, that any propelling force should be given by the left hand to the lithotrite.

It is my practice to wash out the bladder two or three times with boracic acid solution before proceeding to crush. I consider this process beneficial inasmuch as it cleans out the bladder before any considerable injury to the mucous membrane has taken place. For this washing out I always employ, as before stated, the hydrostatic douche at an elevation of about thirty inches. I generally leave from four to six ounces of solution in the bladder. The position of the stone is then carefully recognised and its seizure gently effected. The screw is applied slowly and deliberately. The stone is then crushed and the process repeated as often as possible until the débris is sufficient in quantity to become a hindrance. The evacuating syringe is then applied to the handle, the stop is withdrawn, and the male blade protruded. The bladder is then very carefully washed out, only a very small quantity of fluid being injected. This process of crushing and evacuation is continued until the stone is completely removed. This fact may be ascertained first by the absence of the passage of any débris and of the click of any large fragment against the jaws, and secondly by thoroughly exploring the bladder with the closed lithotrite. When using the instrument as a sound the blades should be screwed tightly home so as to prevent any rattling. The instrument is then withdrawn, leaving, as I have found best, from four to six ounces of boracic solution in the bladder. This operation, if carefully conducted, inflicts a minimum of damage on the urinary passages. It requires, however, great delicacy of manipulation and is apt to be more prolonged than lithotrity with the ordinary instruments. Two points should always be regarded in operating on old men: firstly, to practise the most extreme gentleness compatible with rapidity; secondly, to thoroughly explore the post-prostatic pouch and at the same time to fully utilise the advantages presented by it as a trap for fragments. The after-treatment of such cases is often as important as the operation itself. The bladder treatment should be entirely symptomatic. If it empties itself completely it should be allowed to do so; if not the urine should be drawn off with a sterile catheter every four or six hours. An alkaline condition of the urine should be treated by bladder douches, of which the best is, as I have found, a weak solution of permanganate of potash. A diminution of quantity of the urine should be obviated by demulcent drinks, such as barley water, and if necessary by diuretics, of which I think the best is diuretin. The patient's strength must be maintained by good feeding and by the exhibition of stimulants in such quantity as may be required. In case of febrile symptoms arising salicylate of soda, together with cognac, should be freely used. It is, of course, self-evident that the mortality of stone operations on the aged can never be reduced to the ratios obtained with youths and adults; still, a careful attention to details will considerably diminish the mortality dependent on senile changes. These changes, however, not only largely increase the dangers of the operation, but also in some cases from local alterations render its performance much more difficult. The alterations of the prostate, either in the form of general hypertrophy or the production of tumour, may be such as to cause in the first place great obstruction to the introduction of instruments into the bladder, or in the second more or less complete ensaculation of the calculus. The first difficulty, obstruction to the introduction of instruments, is usually to be overcome by careful manipulation. In some few cases the obstruction may be complete, and some form of cutting operation becomes necessary both for the relief of the retention of urine and for the removal of the stone. In the great majority, however, a fair-sized instrument may be introduced. It is in these cases that the evacuating lithotrite, if it can be introduced, is of chief benefit, as a single introduction of it allows of the completion of the operation. Here, as in most other cases of difficulty in introducing instruments into the bladder, a finger in the rectum is of the greatest assistance.

The retention of the calculus in a pouch behind the enlarged prostate is a matter of much greater importance. In the simpler examples of this condition, in which there exists only a dilatation of the normal trigonal pouch, operation is, as I have before remarked, rather facilitated than otherwise. Where, however, the pouch is more or less separated from the general bladder cavity by constriction of its upper margin, or where, as described by Buckston Browne, an overhanging tumour of the prostate entirely hides the calculus, lithotrity may become extremely difficult or even impossible. Under such circumstances relief can perhaps only be given by some cutting operation, but lithotrity should be, I think. attempted in most cases. It is sometimes possible to dislodge the stone by pressure exercised by a finger in the rectum. In such cases, however, a new point comes into consideration—the treatment of the complication itself. Many operations have lately been performed for prostatic tumour and with very encouraging results, such operations being nearly always performed through a suprapubic opening into the bladder. It becomes, therefore, a matter of consideration as to whether it would not be advisable, in all cases of stones co-existing with any considerable enlargement of the prostate, to remove both stone and tumour through the same opening. There are, however, several indications against the procedure. In the first place the results of lithotrity are, from the point of view of mortality, at any rate greatly superior to those of suprapubic lithotomy. Secondly, the diagnosis of a prostatic tumour likely to be benefited by operation is very difficult so long as a stone is present. Thirdly, after removal of the stone the prostate may give but little inconvenience. Fourthly, the wished-for diminution of the prostate may perhaps be more safely obtained by castration.

I would say, therefore, with regard to the treatment of stone when complicated by old age and its degenerations, that (1) lithotrity is attended in such cases with very much less mortality than any cutting operation and is, therefore, to be performed when possible; (2) that a further advantage may be gained in lithotrity by the use of an evacuating lithotrite; (3) that the minutest care is necessary in all such operations; (4) that where the stone is complicated by evident prostatic tumour the safer plan is to treat the stone first by lithotrity and then to determine on the nature of the interference necessary for the treatment of the prostate; (5) that some cases cannot be operated on by lithotrity and that some cutting operation, preferably suprapubic lithotomy, is necessary; and (6) that lithotrity in difficult cases may be greatly assisted by the manipulations of a finger in the rectum

The next varieties of complications that I have to refer to are those arising from the various pathological conditions of the urinary system. The conditions usually considered of importance are organic disease of the kidneys, cystitis in all its varieties, new growths of the bladder, urethral obstruction, prostatic hypertrophy and tumour, and tendency to hæmorrhage Organic disease of the kidneys, as evidenced by the quantity of urine passed and by the presence of urinary casts, undoubtedly furnishes a very important item in prognosticating the result of any operation. Still, there is no condition of the kidney which could be taken as a contra-indication to operation. When, however, the question arises as to which operation, the crushing or the cutting, is likely to yield the better result it becomes very difficult to adduce trustworthy evidence. Lithotrity has, however, proved itself to be the best operation for cases of stone in general; and as pre-existing kidney disease is generally held responsible for the fatal results occurring amongst patients of middle age, this operation, yielding as it does the smallest general mortality, is probably the best suited to meet this special complication. The existence of severe cystitis is also an important element in cases of stone. Here, however, we stand on much surer ground in deciding between the merits of the two operations. The cystitis which is so frequent a companion of stone generally disappears after its removal. My experience has been very clear on this point, that the cure of the cystitis after lithotrity has been as certain as after lithotomy. As to the rapidity of the cure evidence is lacking, as until the urine passes per urethram instead of by the perineal or other wound it is difficult to determine the condition of the bladder. In lithotrity cases, however, the cystitis is usually cured long before the period at which a lithotomy wound is closed. I consider, therefore, that the presence of cystitis, however severe, is no contra-indication to lithotrity. There are, however, two points which must not be lost sight of. The one is that fever is by no means uncommon after lithotrity in severe cases. This fever is, I believe, as a rule due to septic absorption from the bladder and urethra and may call for active treatment. The rise of temperature may be accompanied by diminution in the quantity of urine secreted, a condition which cannot fail to give rise to anxiety.

The treatment of these complications after lithotrity has in Egyptian subjects been so successful as to become practically a routine If there is fever salicylate of soda is given in doses of 1 gramme every two hours for four doses and then every four hours as long as necessary. If there is diminution of urine diuretin is given in similar doses every four hours. When there is persistent cystitis the patient receives 0 30 grammes of methylene blue daily. This latter drug I have found most useful for cystitis, and it is particularly beneficial from its anodyne action. In very severe cystitis, especially if accompanied by atony or by a cystic condition of the bladder, whether after lithotrity or otherwise, a perineal incision and drainage of the bladder is the most certain cure. Still, although in a few very rare instances a lithotrity may require to be followed by a perineal incision. it is better in my opinion to resort to the cystotomy as a secondary than as a primary operation. The presence of a tumour in the bladder greatly complicates any stone operation, so much so that one would be justified rather in looking upon the tumour as the important disease and the stone as the complication In most cases, however, the tumour is unsuspected until disclosed by the operative procedures ; in many cases even the suspicion does not arise until after removal of the stone symptoms persist the significance of which was previously masked by its presence. In a few cases the presence of a tumour may be suspected from the results of sounding or other examinations. As to symptoms, I would call attention to two only: the first is the presence of an unusually large quantity of blood in the urine, which frequently occurs in these cases and should raise suspicion, and the second is the passage by the urethra of a fragment, microscopical or other, of a tumour, which seldom occurs, but which assures diagnosis. The age of the patient has a certain importance. In my experience the simple papillomatous tumour of the bladder exists much more frequently in youth than in adult life. Age, of course, predisposes to malignant tumours. The signs yielded by a benign bladder tumour on examination are, as a rule, not very evident, and their detection is, of course, rendered much more difficult by the existence of a stone. A small mobile papilloma has been detected by a sound, but in my own experience, at all events, it has been detected more often than it existed. A villous tumour is, I believe, not capable of detection by any manipulation except in very rare cases. The examination should always be bimanual—that is to say, between the sound in the bladder and a finger in the rectum, between the same sound and a hand over the pubis, and between the finger in the rectum and the hand over the pubis. A large carcinomatous infiltration of the bladder may be generally very easily recognised; smaller tumours, however, although malignant, frequently escape detection. The cystoscope may be used in doubtful cases should the condition of the urine admit of it, and in practised hands may yield very useful information. During the operation for stone the tumour, if of any size, may usually be detected. Any form of cystotomy, laying the bladder open as it does to digital exploration, renders its detection very easy. This exploration can be carried out most easily through a suprapubic incision, but can in most cases be as effectually performed through a lateral perineal wound. During lithotrity also a tumour is, I think, generally detected unless very small. It may show itself by extra difficulty in the manipulation of the lithotrite. In most cases fragments of tumour are brought away either in the jaws of the instrument or through the evacuator. A bladder tumour having been detected in conjunction with a stone, what is the best line of treatment to pursue? The course to be pursued depends on the age of the patient, the probable nature and size of the tumour, and on the size of the stone. If the patient be young, the tumour probably benign, and the stone not very big, the removal of the stone should be considered as secondary to the removal of the tumour, and therefore a suprapubic cystotomy be performed. In a similar case, should the stone, however, be large, I think that the safer proceeding would be to remove the stone first by lithotrity and to perform a suprapubic cystotomy later for the removal of the tumour. I am led to this conclusion by the fact that whereas the mortality after suprapubic cystotomy for tumour is small the same operation for large stones is still attended with great risk. On the other hand, should the tumour have bled freely, especially after examination with a sound, the suprapubic operation should, perhaps, have the preference, as lithotrity in such a case has been followed by very severe or even fatal hæmorrhage. Should the patient be old, should the tumour be probably malignant, and should the question of extirpation of the tumour be not entertained I should recommend the removal of the stone by lithotrity. I have performed this operation in three cases of evident carcinoma of the bladder—in all with success. The presence of the tumour, while rendering the operation more difficult and necessitating great care, produced no untoward after-symptoms. I would say, therefore, that in a case of stone and tumour diagnosed as existing in the same bladder the choice of operation lies between suprapubic cystotomy and lithotrity, and that the first is in general indicated whenever the tumour is to be removed and the second whenever this is impossible; that in the case of a very big stone it may be advisable to do the two operations at different times; and, finally, that the presence of a tumour, unless it be very prone to hæmorrhage, is not an indication against the performance of lithotrity. Urethral obstruction may, of course, be an absolute bar to lithotrity. Generally, however, the stricture is capable of cure, and then the question may arise as to the superiority of the various methods for the removal of the stone. If the stone be small I should consider the stricture as the more important, and should treat it first by dilatation or (in bad cases) by perineal incision. In the first case I should remove the stone by a subsequent lithotrity and in the second I should remove it at once through the perineal wound. On the other hand, should the stone be large (say, over thirty grammes) I should consider it to be the more important disease—firstly, on account of its size, and secondly, because the introduction of large crushing instruments is often difficult, even after complete dilatation of a stricture. In such cases I should recommend a perineal incision, followed by crushing of the stone and its removal through the wound. Where the stricture is such as not to admit the smallest staff it may be advisable to dilate the urethra first and then to perform perineal lithotrity. Briefly, then, I would say, when the stricture is incurable and no staff can be introduced suprapubic cystotomy becomes almost a necessity. When the stone is large and a staff will pass perineal lithotrity is preferable; when the stone is small the stricture should be treated by dilatation and urethral lithotrity subsequently performed. Prostatic hypertrophy and tumour I have already referred to in treating of senile degenerations. The tendency to hæmorrhage I have referred to under the observations on bladder tumours. I have never met with anything approaching to severe bleeding in any crushing operation. Should it occur the best method of treatment is to wash out the bladder with a large lithotrity evacuator and syringe. Should it recur, and should the various hæmostatic local applications in the form of bladder douches be ineffectual, I would drain the bladder by a perineal incision and wash it out with an iced creoline solution every two hours. The last category of complications are those arising from the general health of the patient. On this point there is but little to be said. I know of no condition except impending death from other causes than the presence of a stone which contraindicates operation. Heart disease is, unless extremely advanced, rendered innocuous by anæsthesia. Affections of other organs, although requiring the most careful attention before, during, and after operation, do not exclude its performance. Hæmophilia, an extremely rare complication of stone, renders operative interference more than usually imperative, and in such a condition lithotrity is clearly indicated. The general condition of the patient, therefore, may be said to present no indication against the operative treatment of stone, neither does it, with the exception of hæmophilia, specially indicate any one operation. The operation which gives in general the smallest mortality is, however, most necessary when the chances of mortality are increased, and lithrotrity therefore in such cases imposes itself.

In recapitulation I would say:—(1) That litholapaxy—i.e., lithotrity at a single sitting—is certainly the operation of election in all simple cases of stone in the urinary bladder; (2) that the difficulties of lithotrity increase with the size of the stone, but that no stone is too large or too hard to be crushed, and that the results obtained by lithotrity in dealing with stones over two ounces in weight are greatly superior to those ever obtained by any other method; (3) that in cases of large and hard stones in which, from the lack of operative skill and experience, urethral lithotrity is abandoned the best results will be given by a crushing operation performed through a perineal wound; (4) that difficulties in grasping a stone may be obviated by the use of suitable instruments and by cautious dilatation of the bladder; (5) that a considerable proportion of stones encysted in various ways may be removed successfully by lithotrity, and that only when this has been attempted and has failed should cystotomy, preferably suprapubic, be reverted to; (6) that lithotrity is the operation of election in the presence of nearly all morbid changes of the genito-urinary apparatus and should always be attempted, the necessary treatment being afforded to the complication either before or after its performance as required; (7) that in children its results are particularly favourable when carried out by experts, but that for the present lateral lithotomy is the safer operation in many hands; (8) that in the presence of senile degenerations and of morbid alterations of the general system lithotrity is by far the best operation and should be carried out whenever possible; and (9) that the completion of the operation by means of a single instrument—the evacuating lithotrite—may be advantageous, especially when dealing with old subjects.

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